



Division of Agricultural Sciences
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PRUNING GRAPEVINES



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The success of a vineyard may depend, to a large extent, on the pruning practices employed. This circular discusses the principles of pruning, the relationship between pruning and plant behavior, and the actual methods of pruning on both young and bearing vines.

Spacing and training of vines is not discussed here. That is felt to be another subject and is taken up in other publications.

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Typical mature, head-pruned vine, headed at about 24 inches.



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PRUNING CONSISTS in the removal of canes, shoots, leaves, and other vegetative parts of the vine. The removal of flower clusters, clusters, or parts of clusters is thinning. The removal of the ripe fruit is harvesting.

Pruning has three main functions: 1) to aid in establishing and maintaining the vine in a form which will save labor and facilitate the necessary vineyard operations such as cultivation, the control of diseases and insects, thinning, and harvesting; 2) to distribute the bearing wood over the vine, between vines, and between years in accordance with the capacity of the vines, in order to equalize production and secure large crops of high-quality fruit; and 3) to lessen or eliminate the cost of thinning in the control of crop. Pruning is the cheapest means of reducing the number of clusters.

Pruning distinguished from training

Training, both by derivation and usage, includes certain practices supplementary to pruning which are necessary in shaping the vine. It consists princi-

pally in attaching the vine as it grows to various forms of support. Whereas pruning determines the number and position of the buds that develop, training determines the form and direction of the trunk and arms and the position of the shoots that develop from the buds retained at pruning.

In training the young vine the grower is interested primarily in developing a single strong shoot with several well-placed laterals to form a permanent framework. In doing this he sacrifices some of the vine's crop potential in the early years in order to obtain a well-shaped vine as cheaply and as early as possible. With the bearing vine, on the contrary, the pruner must consider both wood and crop, since a proper balance between them is essential to the development of good fruit and the continued production of large crops. For this reason, training—the development of a young vine of desirable form—will be distinguished from pruning—the maintenance of the established form and the regulation of crop. Pruning will be discussed here. For a discussion of training see Leaflet 111, "Vine Spacing and Training."

Principles of pruning

When a vine has reached the stage of full bearing, pruning consists in the removal of all the growth except 1) bearing units—spurs and fruit canes for the production of fruit and new wood or fruit only; 2) renewal spurs, for renewal or the production of wood for the next year; and 3) replacement spurs, in the case of the older vines, for the replacing or shortening of arms. The old fruit canes and the arms or parts of arms to be replaced are removed.

Shoots are the current season's succulent growth of the vine. Canes are matured shoots. A fruit cane is the basal section of a cane, 8 to 15 buds long, retained to produce the crop on cane-pruned vines. It is always removed at the following pruning. A spur is the basal portion of a cane from 1 to 4 buds or nodes in length left after pruning of the cane. Water sprouts are any shoots that arise on parts of the vine which are older

than one year. Suckers are water sprouts that arise below ground. The term is also frequently applied to water sprouts arising from the trunk.

The length of the bearing units is largely determined by the fruiting habit of the variety to be pruned; that is, by the position on the canes where the fruitful buds are borne and by the normal size of the clusters. On varieties having fruitful buds to the base of the canes, short bearing units are retained. This is called **spur pruning**. On varieties on which the buds toward the base of the cane are sterile (unfruitful) or on which the clusters are very small, long bearing units must be used in order to secure a full crop. When this is done, it is called **cane pruning**. Occasionally bearing units of intermediate length—half-long pruning—are used. Owing to the difficulty of maintaining the shape of vines so pruned, this method is not recommended.

Principles of plant behavior

To accomplish the purposes set forth in the discussion of pruning, one must follow certain principles of plant behavior as they apply to the vine. These are based upon a knowledge of the vine's response to the removal of vegetative or fruiting parts, and upon our present understanding of growth and fruiting habits.

Pruning tends to depress or stunt vines

The removal of living vegetative parts at any time decreases the capacity or total productive ability of the vine. Capacity is largely determined by the num-

ber, size and quality of the leaves and the length of time during which they are active. Pruning during the dormant season reduces the total number of leaves that will be formed during the growing season by restricting the number of shoots and also delays the formation of the main leaf area until well into the summer. It thus reduces *both* the total leaf area and the length of time during which most of the leaves function. In consequence, smaller quantities of carbohydrates, such as sugar and finally starch, will be formed; and the amount available for the nourishment of the roots, stems, shoots, flowers, and fruit will be less.

Thus, to the grower, pruning has two pronounced effects: it concentrates the activities of the vine into the parts left; and it diminishes the total capacity of the vine for growth and fruit production. Correct pruning consists in achieving the first to the extent required while minimizing the second effect as much as possible.

A heavy crop depresses vine capacity

Growers recognize that vines with a very heavy crop grow less vigorously than vines with a light crop, and also that vines which overbear in one year are likely to have a lighter crop the following year. For example, the crops of 1938, 1943, 1946, 1951 and 1955 were outstanding in volume. These years of excessive overcropping were in each case followed by lower yields. Owing to other conditions such as unusually favorable weather, etc., the years of lowest yield did not always immediately follow the heaviest crops. But they did follow.

Vine capacity related to total leaf area

Vine capacity is directly related to the number of shoots that develop and the resulting total leaf area. A vine with only a few shoots that elongate very rapidly will appear vigorous. Yet it will be excelled in production by another vine which makes less show of vigor, by reason of having numerous shoots of slower growth, but nevertheless produces a larger total leaf area.

Size of crop related to number of shoots

The fewer shoots permitted to develop, the smaller the crop, and the more vigorously each shoot will grow. This inverse relation between number of shoots and rate of growth finds special application in the development of young vines where a single strong shoot is desired to

form the trunk. (See Par. 2 "Pruning distinguished from training.") Similarly, the fewer the arms, the more vigorous each will be. This rule also applies to the fruit. To obtain large clusters, one must limit their number (several weeks before bloom); and if large berries are wanted, there must not be too many on a cluster.

Normal crop

A given vine in a given season can nourish and ripen properly only a certain quantity of fruit; that is, its capacity is limited by its previous history and its environment. Within the limit of a vine's capacity to bear fruit, the date of ripening is determined mainly by heat and cannot be hastened by further reductions in crop. The maximum amount the vine will bear without delaying maturity is therefore an index to its bearing capacity. This is its "normal crop." As the crop is increased beyond this point, the first effect is delayed maturity. Further successive increases in crop result in low sugar and low acid content, waterberries, drying of the tips of the clusters, reduced growth, immature wood, and poor fruit-bud formation. The latter will limit the crop of the following year.

Growth and fruiting relationships

In addition to the above principles, the following relationships of growth and fruiting should be observed by the pruner:

The first growth in spring usually comes from the buds nearest the ends of canes or spurs, and those on the highest parts of the vine. This earlier start gives the shoots from such buds an advantage over later-starting shoots. Besides, a vertical position of a cane or growing shoot, through its effect on polarity, tends to retard the development of buds on the middle and lower parts of canes, and the laterals on erect-growing shoots. In pruning, therefore, efforts are made to neu-

tralize the effects of position on growth. The spurs of head-pruned vines are formed and maintained near a common level or equal exposure. The trunks or branches of cordon vines that bear the spurs are trained in a horizontal position, with the spurs at a common level. Vertical cordons cannot be maintained, competition and shading causing the lower arms to weaken, making necessary their removal after a few years. In cane pruning the fruit canes are also bent down and tied in a horizontal position on the trellis.

On the basis of the observations that the fruitful buds of the vine occur most abundantly on one-year-old canes that arise from two-year-old wood, the pruner should select for fruit spurs and fruit canes the basal segments of canes which come from two-year-old wood. As a rule such canes start growth at about the same time their wood matures uniformly, whereas canes arising from older wood may start late and grow more rapidly, resulting in poorly matured wood. Time of growth and the normal maturing of the shoots into canes is more important than position. Yet, to many pruners, position of origin is the simplest means of

indicating canes that usually are well matured.

Fruit buds are formed during mid-summer. Conditions of good vine nutrition, moderately vigorous shoot growth, and moderate crops favor their abundant formation. Length of internode, the space between buds, is an index to the type of growth that the shoot made. Those shoots formed at the beginning of the season which make regular growth will have internodes of normal length for the variety. The fact that a cane has internodes of normal length, other conditions being favorable, indicates good bud development and a well-matured condition of the wood. Canes with abnormally long internodes should be avoided.

Capacity and total growth

As stated, capacity is directly proportional to total growth. A cane of large size, while having greater capacity than a small one, is, however, likely by its continued vigorous growth to produce less fruitful buds. This being the case, a large cane should be pruned so that its growth will be restrained and the spur or fruit cane retained will carry more buds than are supported by smaller canes.

Time of pruning

Generally pruning is done while the vine is dormant, between leaf-fall in the autumn and the starting of growth in the spring. The time of pruning within the dormant period—between December 1 and March 1—has little or no influence on the vigor of growth or production of fruit the following season, if the vines are not frosted after growth starts. Very late pruning may, however, slightly delay the time when growth begins. Hence, by not pruning until the upper buds on the canes have grown an inch or two, one may re-

tard the starting of the lower buds (those on the spurs) as much as a week or ten days, and these may escape damage if frost occurs within that period.

Only very late pruning considerably affects the time of starting growth, except for a few areas in southern California and the Central Coastal counties. In these areas late pruning has also resulted in marked increases in yield. The reason for this difference in response to time of pruning is not fully understood at the present time.

Pruning systems

The various styles of pruning used in commercial vineyards in California may be grouped into three main classes or systems—namely, head, cane, and cordon.

Head Pruning

In the head system the mature vine has a vertical stem or trunk, 1 to 3 feet high, bearing at its summit a ring of arms or short branches. Each winter pruning spurs are left at the ends of these arms to produce the shoots that will bear the next crop and furnish canes for the next year's spurs. Thus, this system consists of head training and spur pruning. The point or region where the trunk separates into the arms is called the head.

The advantages of head pruning are simplicity of form, ease of training, and cheapness. The headed vine is the easiest type to establish, largely because the trunk is relatively short and upright. The cost of support is relatively low. During the developmental period stakes are necessary; but after five to ten years the trunks are rigid enough to be self-supporting. Cross-cultivation is possible, a feature that may be advantageous when the control of noxious weeds is a problem.

The disadvantages of head pruning lie chiefly in the depressing effect of severe pruning on the growth and productivity of the vines and in the massing of the fruit within a small area. When the crop is controlled entirely by pruning, as with most head-pruned varieties, the pruning must be severe in order to prevent overbearing.

Head pruning suits most varieties that bear well on short spurs. It is used for most wine grapes and for a few table varieties.

Cane Pruning

In cane pruning, the vine is given a trunk similar in form to that in head pruning. The head of the vine differs in being fan-shaped in the plane of the trellis. Only two arms on each side of the head are usually needed. At each annual pruning, after the vines are mature, fruit canes eight to fifteen buds (2 to 5 feet) in length are retained for producing the crop. The old fruit canes are removed each year. The production of canes for use the following year is left largely to the renewal spurs, usually two buds long and located near the base of each fruit cane.

Cane pruning is necessary for varieties, such as the Thompson Seedless, that have mostly unfruitful buds near the base of the canes. It also insures full crops with varieties that produce very small clusters, such as the Cabernet Sauvignon, the White Riesling, Sauvignon blanc and some of the Pinots. Combined with appropriate thinning to regulate crop, it offers other advantages: the fruit may be distributed over a large area; the tendency of certain varieties, like the Muscat of Alexandria and the Dattier, to set shot (small seedless) berries and produce straggly clusters may sometimes be reduced; and, since there will be more clusters than are needed for a crop, the grower may eliminate the least desirable ones by thinning, and thus improve the average quality of the fruit.

The disadvantages of cane pruning are twofold: the tendency of most varieties to overbear, with consequent production of poor fruit unless adequate thinning methods are employed; and the high cost of both pruning and of supports—a trellis is usually necessary. For raisin and wine grapes the simple two-wire trellis is sufficient; but for fine table grapes a wide-topped trellis is better because the fruit

A photo of a head-pruned vine appears on page 2.

hangs free and is more uniformly exposed. As with all trellised vines, cane pruning usually prevents cross-cultivation.

Cordon Pruning

Cordon-pruned vines have no definite head. The trunk, which is much elongated either vertically or horizontally, has arms at intervals of 8 to 12 inches over the greater part of its length. In California only the horizontal bilateral form is recommended. The trunk rises vertically to a point about 8 inches below the supporting wire of a trellis. At this point it divides into two equal branches, which rise to the wire in a gentle bend and extend in opposite directions along the wire to within 8 to 12 inches of the cordons of the adjacent vines on either side. The bends should be smooth and

regular; the horizontal portions straight. No shoots should be permitted on the bends of the mature vines. The bearing units are spurs on short arms located at regular intervals on the horizontal part of the branches. They should, wherever possible, be on the upper side of the branches or at least extend in an upward direction if they originate elsewhere.

The fruit on horizontal cordon-pruned vines is well distributed, with all clusters hanging at about the same distance from the ground, a condition favorable to uniform development and maturation of the fruit. Some varieties that require long spurs with head training bear fair crops on spurs of normal length with the cordon system.

The greater length of the trunk of the vines makes the cordon the most laborious and most expensive system to estab-

A mature, cane-pruned vine on a 4-wire, sloping-top trellis, headed at 48 inches. Many cane-pruned vines are grown for producing raisin or wine grapes.



lish. Not only is more work required, but the labor employed must be more skilled; and a trellis or some other permanent support is essential. Once established, the pruning of these vines is simple.

In California cordon pruning is well adapted for table-grape varieties, particularly Cardinal, Emperor, Malaga, Red Malaga, Ribier, and Tokay. It also has advantages for the vigorous wine-grape varieties that produce very large clusters.

Pruning bearing vines

Head pruning of bearing vines

On a mature vine, the number and length of spurs left the previous year, together with the size of the canes and the number of clusters produced during the current season, may be used as a guide in determining the number and

length of the spurs to leave on a vine. (The number of clusters produced may be determined by counting the stubs left where the clusters were cut off.) A vine that produced a good crop and has canes of normal size should be pruned to about the same number of spurs of similar

A mature, horizontal, bilateral, cordon-pruned vine on a 4-wire sloping-top trellis. One wire supports the cordons; the upper wire on the sloping crossarm is not shown.



length (as measured by the number of buds) as the year before. If the canes are abnormally large for the variety, indicating that the vines were very vigorous the previous summer, more spurs, or longer spurs, or both, should usually be left in order to utilize this capacity in the production of fruit. If, on the other hand, the canes appear weak—that is, small for the variety—fewer buds should be left. To reduce the number of buds, one may reduce the number of spurs retained or may cut the spurs shorter. Spurs retained from large or vigorous canes should carry more buds than those retained from small or weak canes.

A good rule-of-thumb for the inexperienced pruner to follow is to retain one bud (not counting base buds) on spurs that are the diameter of an ordinary lead pencil; two buds on spurs as large as one's little finger; three buds on those as large as the middle finger; and four buds on spurs as large as the thumb. Base buds, that are not to be counted, include all buds within one-fourth inch of the base of the cane. In general, the medium sized canes—those proper for 2- and 3-bud spurs—are the best.

The spurs should be so placed that the form of the vine is maintained or improved and the fruit uniformly distributed. Whenever possible, canes from near the base of last year's spurs should be used for the new spurs. The arms elongate from year to year. When an arm becomes too long it should be shortened to a replacement spur made from a water-sprout or other suitably located cane.

Cane pruning of bearing vines

The renewal spurs cut to two buds the previous season should have produced two good canes apiece. On a properly shaped vine the uppermost cane on the spur would be used for the fruit cane, and the lower one cut back to two buds to form the new renewal spur. Wherever feasible this practice should be followed.

If, however, enough good canes cannot be obtained from those on renewal spurs, then canes arising near the base of the old fruit canes, or even well-matured water-sprouts, may be used for the new fruit canes or renewal spurs.

The number of fruit canes needed varies from one to six, according to the size and total growth of the vine. The length of these canes depends upon their individual size: large ones, a half-inch or more in diameter, may be left to a maximum length of fifteen buds; small ones should have proportionally fewer buds. If the crop is to be regulated by thinning, as with all table varieties when cane-pruned, a standard number and length of fruit canes may be adopted, and the crop on each regulated according to its capacity.

The renewal spurs should usually be as numerous as the fruit canes and should be given preference over fruit canes in choice of position so as to maintain or improve the form of the vine.

Cordon pruning of bearing vines

Since the annual pruning of the cordon vine consists in cutting to spurs, it resembles head pruning; in choosing the wood and estimating the number of buds to be left, the pruner proceeds in exactly the same way. To maintain the capacity of the individual arms at the same level, the length of the spurs left must be regulated in accordance with the size of the canes from which they are made, as with head pruning. Sometimes one-bud replacement spurs at the base of the long fruit spurs or further down on the arm may be used advantageously.

Summer pruning

Suckering, crown suckering, pinching, topping, and the removal of leaves are the operations in summer pruning. Suckering—the removal of water-sprouts from the trunk and from below ground—should be done carefully and thor-

oughly in every young vineyard and at least once each year in every old one. As a rule, no water-sprouts should be permitted on the undivided portion of the trunk of mature vines either above or below ground.

Crown suckering—the removal of water-sprouts from the branches and arms—should be employed with care. Usually one may open the head of the vine by judicious crown suckering in order to improve the quality of the fruit or to concentrate growth in parts where it is wanted. To remove unfruitful shoots in all cases, however, on the theory that they are useless, is a mistake. The foliage they produce nourishes the vine and makes it more capable of bearing fruit. Also, some shoots may be needed for use as replacement spurs. The constant and thorough removal of all water-sprouts from the large branches and arms admits the direct rays of the sun and causes "bald-headed" vines, which are subject to severe injury by sunburn.

Pinching, the removal of the growing tip of a shoot with thumb and finger, is often useful in arresting the elongation of very vigorous shoots. This operation lessens wind damage and aids in developing young vines. Pinching usually does not stimulate the formation of laterals.

In topping a portion of 1 to 2 feet is removed from the end of a growing shoot, usually during early summer. In very windy districts the practice may sometimes be advisable, for it may be better to cut off a part and save the remainder than to allow the wind to break off the entire shoot. However, since leaves are removed the practice does weaken the vine; and severe late topping may depress the next crop by as much as 70 per cent.

Judicious removal of leaves sometimes helps certain varieties, such as Emperor, to color. The operation opens the vines, permitting better exposure of the clusters. If the leaves are left on until the fruit has attained the minimum sugar content desired, neither the vine nor the fruit will be harmed. If many leaves are taken away before the fruit reaches the minimum sugar content for harvest, ripening may be retarded. To improve the coloring of the fruit one should remove only the leaves in the head of staked vines and those on the lower part of the north or east side of trellised vines.

To aid in the production of fine table grapes one may remove, soon after the berries are set, any leaves that will rub the clusters and any tendrils that may intertwine the clusters.

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